Development Policy

Week 2: Growth Theory and Empirics

Lecture 3: Growth Theories

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Growth Theories: Overview

Harrod-Domar model:

- Not intended as a growth model, but adopted by the pioneers of development economics and international aid agencies (e.g. World Bank)
- Everything is about capital accumulation; no role for employment, technology change or factor substitution (i.e. pure classical assumptions)
- Assumes closed economies

Solow model:

- A pure growth model for which Solow won the Nobel prize; based on neo-classical assumptions (factor substitution and diminishing returns to factors).
- Ultimately it's all about exogenous technology change; in the short-run capital deepening plays a positive but diminishing role.
- Assumes closed economies, though this is not widely recognized.

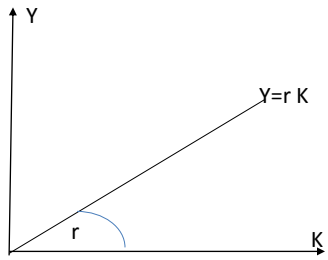
Endogenous growth models

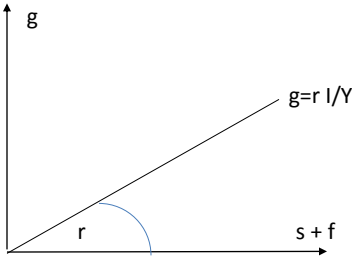
- Okay, it's all about technology change, but what determines technological innovation? Endogenous growth theory aimed (unsuccessfully) to answer this question.

Technology catch-up a la Lucas

- In LDCs, its technology catch-up (diffusion), not innovation that explains technology change. Technology catch-up is endogenous and subject to diminish returns. Strongly supported by the data for open economies.

Harrod-Domar Model





$r = Y/K$ = constant

$r = \Delta Y / \Delta K$

$\Delta K/\Delta Y = 1/r$ = ICOR

$\Delta Y = r\,\Delta K$

$\Delta Y/Y = r\,\Delta K/Y$

$\Delta K = I = S + F$

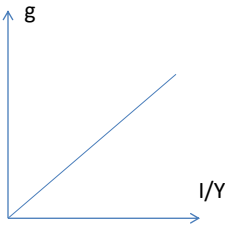
$I/Y = S/Y + F/Y = s + f$

$\Delta Y/Y = g = r\,(I/Y) = r\,(s + f)$

Financing gap:

- Target rate of growth (g_T) = 5%
- ICOR = 4, i.e. r = 0.25
- Required saving rate (s_R) = 20%
- Domestic saving rate (s) = 12%
- Financing gap (f) = 8%

Harrod-Domar Model: Easterly's Test of the Model



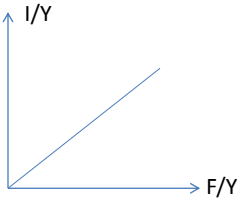


Table 3: Results of regressing GDP Growth on Gross Domestic Investment/GDP with a constant, country by country, 1950-92

Coefficient of Growth on Investment/GDP	*Number of countries*	*Percent of Sample*
Total sample	138	100%
Positive, significant, "zero" constant, and 2<ICOR<5	4	3%
Positive and significant	11	8%
Positive	77	56%
Negative	61	44%
Negative and significant	10	7%

Table 1: Results of regressing Gross Domestic Investment/GDP on ODA/GDP country by country, 1965-95

Coefficient of Investment on ODA	Number of countries	Percent of Sample
Total	88	100%
Positive, significant, and >=1	6	7%
Positive and significant	17	19%
Positive	35	40%
Negative	53	60%
Negative and significant	36	41%

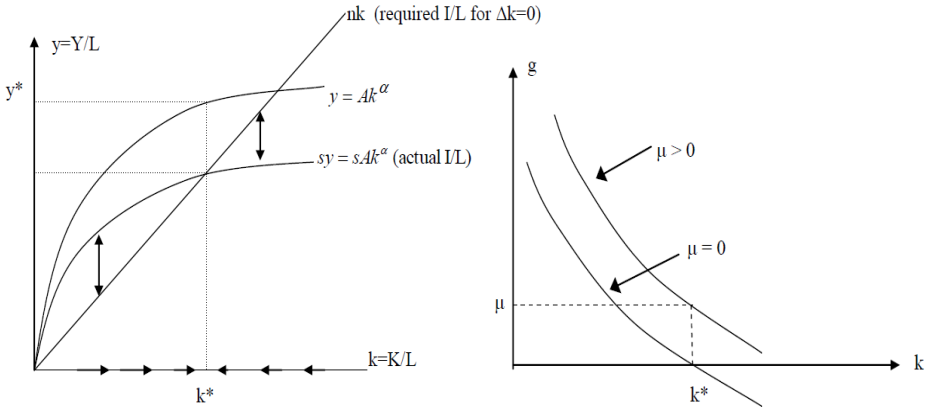
From William Easterly "The Ghost of Financing Gap: How the Harrod-Domar Model Still Haunts Development Economics," *Journal of Development Economics*, 60 (2), December, 1999, 423-438.

Solow Model

$Y = AK^{\alpha}L^{1-\alpha} \quad 0 < \alpha < 1$
$y = Ak^{\alpha} \quad y = Y/L \quad k = K/L$
$g = \mu + \alpha(\Delta k/k) \quad \mu = \Delta A/A$
$\Delta k = sy - n \cdot k \quad n = \Delta L/L$

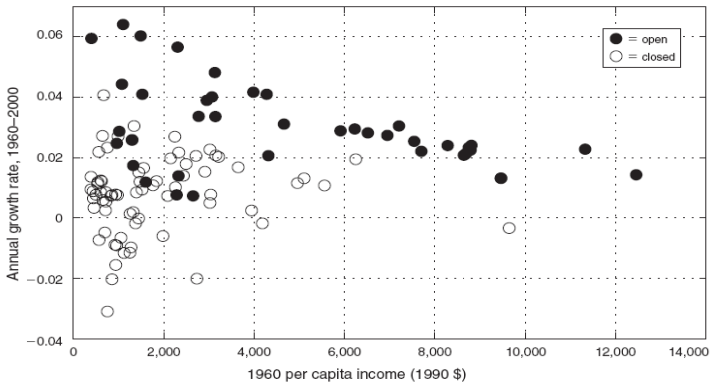
Two sources of growth:

1. Capital deepening which diminishes to zero at steady state
2. Technology change which is constant and continuous



Solow Model—A test of convergence

1. The key empirical result of the Solow model is convergence—the lower a country's initial level of y, the faster it will grow.
2. In the neo-classical model, convergence is not predicted in open economies, only in closed ones. Why?
3. But, convergence does not hold empirically in closed economies, only open ones!
4. Something is clearly wrong (missing) in the Solow model. What?



Endogenous Growth Theory

A class of growth models that attempted to correct for the deficiencies of the Solow model: (1) In the Solow model it's all about technology, but the theory does not provide an explanation of technology change and (2) theory predicts convergence, but convergence is generally not observed empirically.

Selected Endogenous Growth hypotheses:

1. Learning by doing. Technology change is endogenous to the capital stock. The capital stock is a proxy for accumulated knowledge/technology: $A = K^{1-\alpha}$. When substituted into the production function yields a model much like Harrod-Domar, but base on different logic: $Y = AK^{\alpha}L^{1-\alpha} = K^{1-\alpha}K^{\alpha}L^{1-\alpha} = constant \times K$.
2. Number of people engaged in discovering new ideas. Technology is endogenous to the population. As the population grows, more people are engage in technology discovery and technology progresses, giving rise to more income, more people and hence more technology.
3. Human capital. Technology advances as a result of investment in human capital. Because of the spillover from investment in human capital to the productivity of physical capital, physical capital exhibits constant, not diminishing, returns.
   $Y = K^{\alpha}H^{1-\alpha} = K \cdot (H/K)^{1-\alpha} = constant \times K$

None of these models has proved able to provide a general explanation of technology change.

Technology Catch-Up a la Lucas

Technology catch-up is a theory of growth in open developing economies that accords well with the empirical evidence.

Technology catch up is achieved by absorbing new and better technology from abroad by investing in imported machinery and equipment, attracting FDI, and investing in international state-or-art methods of management and business. Therefore, technology change in open developing countries is endogenously determined by investment.

Technology change is endogenous and is subject to diminishing returns:

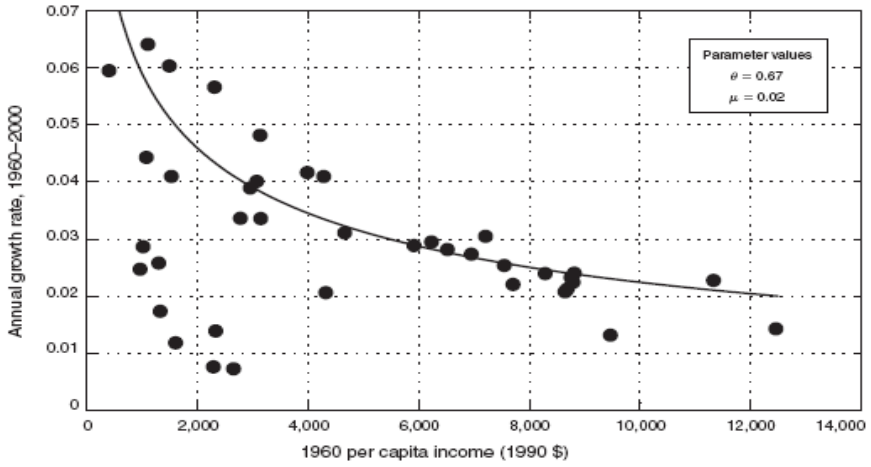
$$g = \mu\left(\frac{\bar{y}}{y}\right)^{\theta} \qquad 0 < \mu < 1$$

Where μ is the exogenous rate of growth of the technology frontier, $\bar{y}$ is per capita income at the frontier, y is income in a late-comer developing country and θ is the technology spillover coefficient.

If the technology spillover coefficient is less than one, then technology catch-up is subject to diminishing returns and convergence obtains across open developing countries over time.

Technology Catch-Up a la Lucas

Setting values for μ (=0.02), θ (=0.67) and ($\bar{y}$=12,000) Lucas computed the potential growth rate of as sample of 39 (out 112) open economies. The computed potential growth is compared to actual growth rate for the sample open economies

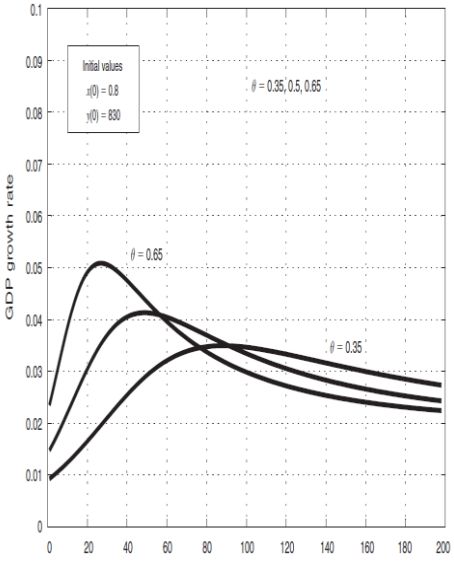


Technology Catch-Up with Labor Reallocation

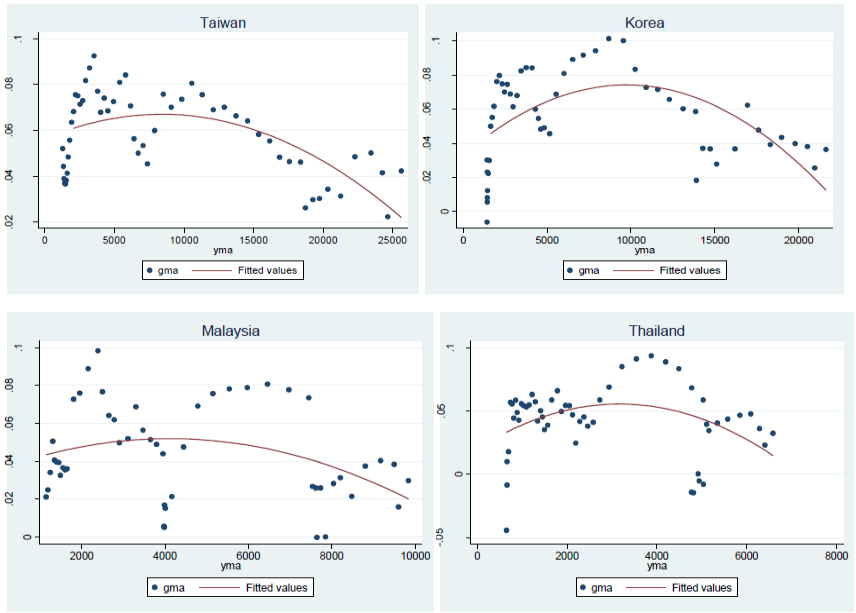
Technology catch-up is subject to diminishing returns and predicts convergence, but in many developing countries growth slows down only after an initial period of growth acceleration.

Growth acceleration can be explain by the growth dividend that derives from reallocation of labor from agriculture (where productivity is low) to industry (where productivity is relatively high).

Technology catch-up is concentrated in industry. As industry expands, labor is drawn out of agriculture and average productivity increases, generating rising growth rates in the early phase. Eventually, the effect of labor reallocation diminishes and convergence effect of take over.



Per capita income growth patterns in selected Asian countries



Why growth slows down in the middle income range

What explains growth slowdown in the middle-income range?

1. Natural consequences of catching up
   - Diminishing returns to capital deepening (Solow)—closed econ
   - Diminishing returns to technology catch-up (Lucas)—open economies
   - Diminishing returns to labor reallocation—all economies

2. Growth-inhibiting policies
   - Policy making failures
   - Market failures (coordination and information externalities)

3. Political Growth Trap
   - Economic reform stalls in the middle income range when policymakers/politicians seek to maximize rent-seeking.

   - Why does rent-seeking stalls reform in the middle income range?

Political Growth Trap: An Hypothesis

An hypothesis: Policy makers are rent-seekers and set policy to maximize the rent they earn from exercising discretionary power to grant privileges to favored firms and individuals (e.g. licenses, land-use rights, contracts, employment, etc.)

Rent (R) depends on policy (P) via two channels:

- The higher P, the less discretionary power in the hands of the authorities, the ***smaller the scope*** for rent-seeking
- The higher P, the fewer distortions in the economy, the larger the economy, hence the ***larger the scale*** of rent seeking

$$R = R(P, Y(P)..) \quad R'_P < 0 \quad R'_Y > 0 \quad Y'_P > 0 \;\Rightarrow\; (2)$$

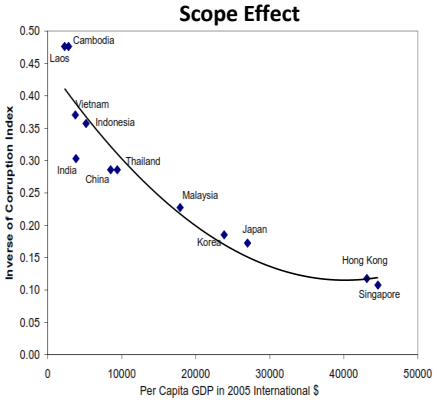
$$dR/dP = R'_P + R'_Y \cdot Y'_P$$

The first term on RHS of (2) is negative (scope effect), the second term (scale effect) is positive. If the income effect of policy reform is subject to diminishing returns ($Y''_P < 0$) the scale effect dominates initially at low income and the scope effect dominates subsequently at high income—yielding an inverted-U relationship between R and P.

The Political Growth Trap: An Illustration

In the absence of direct empirical evidence of a political trap, I offer an illustration using the inverse of a widely-cited index of corruption perception (CPI)—the higher CPI the higher the level of perceived corruption. Figure A illustrates the scope effect and Figure B the combined scope and scale effects.

Scope Effect



Scope + Scale Effect